



Serial No.: 10/756,830

R E M A R K S

I. Introduction

In response to the pending rejection, Applicants respectfully submit that the cited prior art does not disclose or suggest the present invention as recited by the pending claims for the reasons set forth below, and therefore request that the pending rejections be withdrawn.

II. The Rejection Of Claims 1-4, 8-11 And 15-18 Under 35 U.S.C. § 103

Claims 1-4, 8-11 and 15-18 were rejected under 35 U.S.C. § 103 as being obvious over USP No. 6,777,142 to Pierrat in view of USP Pub. No. 2004/0122636 to Adam. Applicants respectfully submit that the pending claims are clearly not obvious in view of Pierrat and Adams taken alone or in combination with one another, for at least the following reasons.

As noted in the Applicants' previous response, the present invention relates to a novel method for placing optical proximity correction (OPC) features within a mask design that allows for deep sub-wavelength mask patterns to be imaged using substantially any illumination condition through pitch. The method of the present invention entails **generating an “interference map” based on the target pattern which defines areas of constructive interference and destructive interference between the features to be imaged and the field areas surrounding and adjacent to the features to be imaged. Once the areas of constructive and destructive interference are identified, assist features are placed in the target pattern based on the locations of the areas of constructive and destructive interference.** Referring to Applicants' specification, the interference map illustrates whether each point in the field surrounding the desired target point interacts constructively (i.e., making the intensity of the transmitted light on

the target pattern greater), destructively (i.e., making the intensity of the transmitted light on the target pattern lower) or is neutral (i.e., not altering the intensity of the light on the target pattern).

Turning to Pierrat, *Pierrat does not disclose generating an interference map as recited by the claimed invention.* Col. 4, lines 17-25 and col. 6, lines 17-25 of Pierrat, which are the portions of Pierrat relied upon as disclosing the generation of the interference map, disclose generating an “intensity profile”. An intensity profile is not an “interference map” as defined by the present invention, because an intensity profile does not indicate positive and negative intensities and therefore cannot indicate areas of constructive and destructive interference. As is well known, intensity profiles are based on the square of the electric field at the image plane, and therefore the intensity profile does not indicate areas of both position and negative intensities. As a result, the intensity profile of Pierrat is not capable of identifying areas of constructive and destructive interference and does not correspond to the recited “interference map”.

The generation of the interference map defining areas of destructive and constructive interference is an important aspect of the invention, as this map is then utilized to place assist features within the mask layout to improve imaging. Specifically, assist features having a first phase shift are placed in areas indicated to have constructive interference and assist features having a second phase shift (e.g., 180 degrees opposite the first phase shift) are placed in areas indicated to have destructive interference. By utilizing assist features having different phase-shifts, it is possible to enhance the imaging performance attributable to both the constructive and destructive areas. The fact that Pierrat does not identify areas of both constructive and destructive interference is confirmed by the fact that Pierrat does not disclose or suggest utilizing sub-resolution features having different phase shift properties. It is again noted that just because constructive and destructive interference occurs in each mask (as it does in every imaging

situation), that does not mean that the areas of both constructive and destructive interference are identified and subsequently utilized as taught by the present invention. Clearly, as Pierrat only discloses generating an intensity profile, as explained above, Pierrat does not identify areas of both constructive and destructive interference, and therefore does not disclose or suggest generating an interference map as recited by the pending claims.

Turning to Adam, once again, this reference is wholly unrelated to the present invention and fails to cure any of the foregoing deficiencies of Pierrat. As discussed throughout the specification, Adam relates to the simulation and modeling of electromagnetic scattering of light in imaging systems.

Thus, as each and every limitation must be disclosed or suggested by the cited prior art reference in order to establish a *prima facie* case of obviousness (see, M.P.E.P. § 2143.03), and the combination of Pierrat and Adam fail to do so, it is respectfully submitted that the pending claims are patentable over the cited prior art references.

It is also noted again that Pierrat and Adam clearly fail to disclose or suggest the subject matter recited in the rejected dependent claims. For example, claim 2 recites a specific process for generating the interference map, which entails reducing the size of the features in the target pattern such that they are less than the resolution capabilities of the given system and performing the simulation process on the reduced size pattern. This allows the simulation process to focus on the center of the feature when generating the interference map. Nowhere does Pierrat or Adam disclose or suggest such a process. The statement in the Office Action that Pierrat discloses that the sub-resolution assist features are smaller than the features to be imaged is wholly irrelevant to this claim. As claim 2 is directed to the process of generating the

interference map, not the size of the assist feature. Neither reference even remotely discloses or suggests the recited process.

Turning to other comments set forth in the Office Action, it is submitted that the suggestion that the identification of a phase conflict corresponds to determining interference map is clearly in error. First, based on the foregoing explanation it is clear that simply identifying a phase conflict does not correspond to determining areas of both constructive and destructive interference. Second, the phase conflicts referred to in col. 2, lines 6-9 of Pierrat refer to phase conflicts between the phase shift material utilized to form the features in the mask. For example, two adjacent features which are formed utilizing phase shifting material may be so closely spaced that they print as one feature, and therefore there is a phase conflict between the materials utilized to form the two features. This is the phase conflict being referred to in col. 2, lines 6-9. It does not relate to actual constructive or destructive interference occurring in the resulting image.

Moreover, Pierrat does not disclose placing sub-resolution features to reduce phase-conflicts as suggested in the pending rejection. Pierrat just states that assist features can be utilized in the phase-shift areas, i.e., areas having phase-shift material, (see, col. 2, lines 8-9). As noted above, Pierrat utilizes the intensity profile to place assist features (col. 4, lines 17-24), and the intensity profile is not capable of indicating areas of constructive and destructive interference.

As another example, claim 7 recites that the interference map exhibits a non-zero DC level, which allows the interference map to indicate both positive and negative intensity levels. Once again, Pierrat and Adam are silent regarding any such process. As such, it is also respectfully submitted that the rejected dependent claims are patentable over Pierrat and Adam,

taken alone or in combination, for reasons additional to those discussed above in conjunction with the independent claims.

For all of the foregoing reasons, it is respectfully submitted that the pending claims are patentable over Pierrat and Adam.

III. All Dependent Claims Are Allowable Because The Independent Claim From Which They Depend Is Allowable

Under Federal Circuit guidelines, a dependent claim is nonobvious if the independent claim upon which it depends is allowable because all the limitations of the independent claim are contained in the dependent claims, *Hartness International Inc. v. Simplimatic Engineering Co.*, 819 F.2d at 1100, 1108 (Fed. Cir. 1987). Accordingly, as claims 1, 8 and 15 are patentable for the reasons set forth above, it is respectfully submitted that all pending dependent claims are also in condition for allowance for this reason as well as the reasons set forth above.

IV. Request For Notice Of Allowance

Having fully responded to all matters raised in the Office Action, Applicants submit that all claims are in condition for allowance, an indication for which is respectfully solicited.

If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, the Examiner is requested to call Applicants' attorney at the telephone number shown below.

Please charge any shortage in fees due in connection with the filing of this paper,

including extension of time fees, to Deposit Account and please credit any excess fees to such deposit account.

Respectfully submitted,

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